AMENDMENT

(Amendment under the provision of Article 11 of the Law)

Commissioner of the Patent Office

(Patent Office Examiner Ms. Mamiko ONODERA)

1. Indication of International Application PCT/JP03/08231

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4. Object of Amendment

Specification and Claims

5. Content of Amendment

(1) "(1) An illumination apparatus in which a through-hole for detection is formed at a center portion, and which irradiates diffused light and directional light to an object to be detected, characterized in that at least an annular diffusion plate which diffuses light, light source which were disposed annularly, and an annular reflection plate which reflects light from the light source to the side of the above-described object to be detected, are disposed in the order from the side of the above-described object to be detected, and the above-described diffused light is generated by irradiating light from the above-described light source to the object to be detected through the above-described diffusion plate, and the directional light is generated by reflecting light from the above-described light source by the above-described reflection plate and then, irradiating it to the object to be detected." on page 6, line 22 through page 7, line 8 of the specification is corrected as "(1) An illumination apparatus in which a through-hole for detection is formed at a center portion, and which irradiates diffused light and directional light to an object to be detected, characterized in that at least an annular diffusion plate which diffuses light, light source which were disposed annularly, and an annular reflection plate which reflects light from the light source to the side of the above-described object to be detected, are disposed in the order from the side of the above-described object to be detected, and the above-described diffused light is generated by irradiating light from the above-described light source to the

object to be detected through the above-described diffusion plate, and the directional light is generated by reflecting light from the above-described light source by the above-described reflection plate and then, irradiating it to the object to be detected, and the above-described light source comprises two kinds of a light source for diffused light and a light source for directional light, and an annular fixing plate, on which the light source for diffused light was allocated on a surface which becomes the above-described object to be detected side, and the light source for directional side was allocated on the other surface, was disposed between the above-described diffusion plate and the above-described reflection plate."

(2) Page 7, line 9 through page 7, line 24 of the specification is deleted.

(3) "In this illumination apparatus, two kinds of light sources of the light source for diffused light and the light source for directional light are disposed, and those two kinds of light sources are allocated on front and back surfaces of the fixing plate, and therefore, it is possible to independently control irradiated right from respective light sources, and it is possible to adjust a light amount percentage of the directional light and the diffused light. Therefore, it is possible to make up an appropriate illumination state which accords with a surface state of an object to be detected." on page 7, line 25 thorough page 8, line 7 of the specification is corrected as "In this illumination apparatus, it is possible to irradiate two kinds of directional light and diffused light to an object to be detected, and therefore, even if the object to be detected is of a mirror surface shape or a concavity and convexity shape, it is possible to carry out

appropriate illumination which corresponded to it, and it becomes possible to accordingly carry out stable detection. Furthermore, the directional light, which irradiates the object to be detected, is generated by use of an annular light source and an annular reflection plate, and therefore, it is possible to realize miniaturization with a simple configuration. Then, in this illumination apparatus, two kinds of light sources of the light source for diffused light and the light source for directional light are disposed, and those two kinds of light sources are allocated on front and back surfaces of the fixing plate, and therefore, it is possible to independently control irradiated right from respective light sources, and it is possible to adjust a light amount percentage of the directional light and the diffused light. Therefore, it is possible to make up an appropriate illumination state which accords with a surface state of an object to be detected."

(4) "(3) In the above-described (2)," on page 8, line 8 of the specification is corrected as "(2) In the above-described (1),".

(5) "(4) In the above-described (2) or (3)," on page 8, lines 15 through 16 of the specification is corrected as "(3) In the above-described (1) or (2),".

(6) "(5) In any one of the above-described (1) through (3)," on page 9, lines 1 through 2 of the specification is corrected as "(4) In the above-described (1) or (2),".

(7) "(6) In the above-described (5)," on page 9, line 10 of the

specification is corrected as "(5) In the above-described (4),".

(8) "(7) ~ an illumination apparatus which is described in any one of the above-described (1) through (6)," on page 9, lines 16 through 18 of the specification is corrected as "(6) ~ an illumination apparatus which is described in any one of the above-described (1) through (5),".

(9) "(8)" on page 10, line 2 of the specification is corrected as "(7)".

(10) "which is described in the above-described (7)" on page 10, lines 10 through 11 of the specification is corrected as "which is described in the above-described (6)".

(11) "9" on page 10, line 16 of the specification is corrected as "(8)".

(12) "which is described in the above-described (7)" on page 10, line 23 of the specification is corrected as "which is described in the above-described (6)".

(13) "L2" on page 16, line 1 of the specification is corrected as "L1".

(14) Claim 1 on page 25 of the claims is deleted.

(15) "The illumination apparatus as set forth in claim 1, characterized in that the light source comprises two kinds of a light source for diffused light and

a light source for directional light, and an annular fixing plate, on which the light source for diffused light was disposed on a surface which becomes the side of said object to be detected and the light source for directional light was disposed on the other surface, was disposed between said diffusion plate and said reflection plate." of claim 2 on page 25 of the claims is corrected as "An illumination apparatus in which a through-hole for detection is formed at a center portion and which irradiates diffused light and directional light to an object to be detected,

characterized in that at least, an annular diffusion plate which diffuses light, light sources which are allocated annularly, and an annular reflection plate which reflects light from the light source to said object to be detected, are allocated, in the order from the side of said object to be detected, and the diffused light is generated by irradiating light from said light source to the object to be detected, through said diffused light, and directional light is generated by reflecting light from said light source by said reflection light and then, irradiating it to the object to be detected, and the light source comprises two kinds of a light source for diffused light and a light source for directional light, and an annular fixing plate, on which the light source for diffused light was disposed on a surface which becomes the side of said object to be detected and the light source for directional light was disposed on the other surface, was disposed between said diffusion plate and said reflection plate."

(16) "patent claim" of claim 3 on page 25 of the claims is corrected as "claim".

(17) "patent claim" of claim 4 on page 26 of the claims is corrected as "claim".

(18) "as set forth in any one of patent claims 1 through 3" of claim 5 on page 26 of the claims is corrected as "as set forth in any one of claims 2 through 4".

(19) "patent claim" of claim 6 on page 26 of the claims is corrected as "claim".

(20) "as set forth in any one of patent claims 1 through 6" of claim 7 on page 26 of the claims is corrected as "as set forth in any one of claims 2 through 6".

(21) "patent claim" of claim 8 on page 26 of the claims is corrected as "claim".

(22) "patent claim" of claim 9 on page 26 of the claims is corrected as "claim".

6. List of Attachment

Specification Page 6-10 and 16

Claims Page 25 and 26

can irradiate an object area with illumination light which is optimum on recognizing the object to be detected, but illuminates the object to be detected, with light from a lateral direction, and therefore, can not surely solve the problem that it becomes hard for reflected light from the substrate mark to be incident to the image pickup camera.

The invention aims to provide, in consideration of the above-described circumstance, an illumination apparatus which, even if an object to be detected is of a mirror surface shape and of a concavity and convexity shape, can carry out appropriate illumination which corresponded to it, over trying to realize low cost and miniaturization with a simple configuration, and accordingly enables to recognize an object to be detected without an error, and a recognition apparatus and a component mounting apparatus which were equipped with this.

<Disclosure of the Invention>

The above-described aim is accomplished by the following configuration.

(1) An illumination apparatus in which a through-hole for detection is formed at a center portion, and which irradiates diffused light and directional light to an object to be detected, characterized in that at least an annular diffusion plate which diffuses light, light source which were disposed annularly, and an annular reflection plate which reflects light from the light source to the side of the above-described object to be detected, are disposed in the order from the side of the above-described object to be detected, and the above-

described diffused light is generated by irradiating light from the above-described light source to the object to be detected through the above-described diffusion plate, and the directional light is generated by reflecting light from the above-described light source by the above-described reflection plate and then, irradiating it to the object to be detected, and the above-described light source comprises two kinds of a light source for diffused light and a light source for directional light, and an annular fixing plate, on which the light source for diffused light was allocated on a surface which becomes the above-described object to be detected side, and the light source for directional side was allocated on the other surface, was disposed between the above-described diffusion plate and the above-described reflection plate.

In this illumination apparatus, it is possible to irradiate two kinds of directional light and diffused light to an object to be detected, and therefore, even if the object to be detected is of a mirror surface shape or a concavity and convexity shape, it is possible to carry out appropriate illumination which corresponded to it, and it becomes possible to accordingly carry out stable detection. Furthermore, the directional light, which irradiates the object to be detected, is generated by use of an annular light source and an annular reflection plate, and therefore, it is possible to realize miniaturization with a simple configuration. Then, in this illumination apparatus, two kinds of light sources of the light source for diffused light and the light source for directional light are disposed, and those two kinds of light sources are allocated on front and back surfaces of the fixing plate, and therefore, it is possible to independently control irradiated right from respective light sources, and it is possible to adjust a light amount percentage of the directional light and the

diffused light. Therefore, it is possible to make up an appropriate illumination state which accords with a surface state of an object to be detected.

(2) The illumination apparatus characterized in the above-described (1) that the light source for directional light is attached through a flexible elastic pin from the above-described fixing plate.

In this illumination apparatus, the light source for directional light is attached through the flexible elastic pin, and therefore, it is possible to adjust a directional characteristic of irradiated light of the light source for directional light, by bending the elastic pin.

(3) The illumination apparatus characterized in the above-described (1) or (2) that an illumination control section, which individually controls the light source for diffused light and the light source for directional light, is provided, and the illumination control section carries out a switch operation for switching over lighting of each light source, and an adjustment operation for changing illumination intensity of each light source.

In this illumination apparatus, it is possible to individually control lighting and a light amount of the light source for diffused light and the light source for directional light, by the illumination control section, and therefore, it is possible to make up an appropriate illumination state which accords with a surface state of the object to be detected.

(4) The illumination apparatus characterized in any one of the above-described (1) or (2) that the above-described reflection plate is a side end face of an inner surface of the case which provides accommodation for the above-described light source and the above-described diffusion plate.

In this illumination apparatus, the side end face of the case inner

surface is used as the reflection plate, and therefore, there is no necessity to daringly make the reflection plate separately and to attach it to the case, and it is possible to realize miniaturization of the case and simplification of the case configuration.

(5) The illumination apparatus characterized in the above-described (4) that at least a side end face of the above-described case inner surface is of a white color or a metal color.

In this illumination apparatus, at least the side end face of the case inner surface is colored by a white color or a metal color, and therefore, it is possible to make a reflection capability of light better.

(6) A recognition apparatus characterized by being equipped with the illumination apparatus which was described in any one of the above-described (1) through (5), an image pickup camera which picks up an image of the object to be detected, which was illuminated by the illumination apparatus, and a control section which caries out recognition processing of the object to be detected, by use of the image which was picked up.

In this recognition apparatus, the object to be detected, which was illuminated by the illumination apparatus, is picked up by the image pickup camera, and the control section applies recognition processing to the picked-up image which was obtained, and thereby, it is possible to recognize the object to be detected, with high accuracy.

(7) A component mounting apparatus which has an absorption nozzle, with which a transfer head, which moves on the upper side of a substrate, was equipped, absorbed and held a component, and transfers the above-described transfer head to mount the component on the substrate at a predetermined

position, characterized in that a recognition apparatus which is disposed on the above-described transfer head and detects a mark for alignment which was disposed on the above-described substrate and corrects a mounting position of the above-described component depending on a detection position of the mark for alignment is the recognition apparatus which is described in the above-described (6).

In this component mounting apparatus, even in case that the mark for alignment on the substrate is of a mirror surface such as gold plating, it is possible to detect this mark position with high accuracy, and it is possible to heighten mounting position accuracy of a component.

(8) A component mounting apparatus which has an absorption nozzle, with which a transfer head, which moves on the upper side of a substrate, was equipped, absorbed and held a component, and transfers the above-described transfer head to mount the component on the substrate at a predetermined position, characterized in that a recognition apparatus which is disposed on the lower side of the above-described transfer head and recognizes a component which was absorbed and held by the above-described absorption nozzle is the recognition apparatus which is described in the above-described (7).

In this component mounting apparatus, even if there are a mirror surface and a concavity and convexity surface on a component which is absorbed and held by the absorption nozzle, it is possible to recognize this component with high accuracy, and it is possible to reduce frequency of occurrence of a mounting error.

<Brief Description of the Drawings>

Fig.1 is a sectional side view of an illumination apparatus of the invention.

Fig.2 is a sectional view viewed along A-A arrows of Fig.1.

Fig.3 is an explanatory view which explains a light path of illumination light.

Fig.4 is an explanatory view which shows a pickup image of a substrate mark by an image pickup camera.

Fig.5 is a side sectional view of an illumination apparatus in which a light source for directional light was disposed through an elastic pin.

Fig.6 is an enlarged perspective view which shows a substantial part configuration of the illumination apparatus shown in Fig.5.

Fig.7 is a side sectional view of an illumination apparatus in which illumination light was made to be switchable at the time of diffused light illumination.

is picked up over illuminating it. In that case, in order to heighten a recognition rate and recognition accuracy, there is a necessity to apply illumination light with appropriate light amount and incident angle, to the object 10 to be detected.

As to this point, according to this illumination apparatus 100, light, which was irradiated from the light source 13 for diffused light, becomes diffused light L1 on the occasion of transmitting the diffusion plate 14, and illuminates widely the object 10 to be detected and its vicinity from periphery. In addition, light, which was irradiated from the light source 12 for directional light, is reflected by the reflection plate 17 to become directional light L2, and it passes through each through-hole 21, 22 of the fixing plate 15 and the diffusion plate 14, and illuminates the object 10 to be detected and its vicinity from nearly right above. Therefore, by the directional light L2 from right above and the diffused light L1 from periphery, the object 10 to be detected is irradiated with light with different incident angles. As a result of that, reflected light from the object 10 to be detected and its vicinity passes through each through-hole 21, 22, 18, and is incident to the image pick up camera 20, and thereby, an image with clear contrast is obtained. Therefore, a recognition result by the control section 24 becomes good, and a recognition rate and recognition accuracy are improved.

Fig.3 is an explanatory view for explaining a light path of illumination light by the illumination apparatus 100.

Fig.3(a) shows a situation at the time that the light source 12 for directional light is turned on and the mirror surface shaped object 10 to be detected was illuminated. Light (directional light L2) from the light source 12

for directional light is reflected once by the reflection plate 17 of a ceiling inner surface of the case 11, and irradiates an object 10a to be detected. On this account, the longer a distance La between the light source 12 for directional light and the reflection plate 17, and a distance Lb between the reflection plate 17 and the object 10a to be detected, are, the higher a level of a directional characteristic becomes, and more favorable directional illumination light is obtained. Reflected light from the mirror surface shaped object 10a to be detected is introduced into the image pickup camera 20 through the through-holes 22, 21, 18 of the illumination apparatus 100. Meanwhile, so as for reflected light from the object 10a to be detected, to enter into the through-holes 22, 21, 18, positions of the reflection plate 17 and the light source 12 for directional light are adjusted arbitrarily.

Fig.3(b) shows a situation at the time that the light source 12 for directional light is turned on, and a concave and convex surface shaped object 10b to be detected was illuminated. Light (directional light L2) from the light source 12 for directional light is diffused by a concave and convex surface of the object 10b to be detected, and it seldom or never enter into the through-holes 22, 21 of the illumination apparatus 100.

Fig.3(c) shows a situation at the time that the light source 13 for diffused light is turned on, and the mirror surface shaped object 10a to be detected was illuminated. A light path of light from the light source 13 for diffused light

CLAIMS

1. (Deleted)

2. (Amended) An illumination apparatus in which a through-hole for detection is formed at a center portion and which irradiates diffused light and directional light to an object to be detected,

characterized in that at least, an annular diffusion plate which diffuses light, light sources which are allocated annularly, and an annular reflection plate which reflects light from the light source to said object to be detected, are allocated, in the order from the side of said object to be detected, and the diffused light is generated by irradiating light from said light source to the object to be detected, through said diffused light, and directional light is generated by reflecting light from said light source by said reflection light and then, irradiating it to the object to be detected, and

the light source comprises two kinds of a light source for diffused light and a light source for directional light, and an annular fixing plate, on which the light source for diffused light was disposed on a surface which becomes the side of said object to be detected and the light source for directional light was disposed on the other surface, was disposed between said diffusion plate and said reflection plate.

3. (Amended) The illumination apparatus as set forth in claim 2, characterized in hat the light source for directional light is attached through a

flexible elastic pin from said fixing plate.

4. (Amended) The illumination apparatus as set forth in claim 2 or 3, characterized in that an illumination control section, which individually controls the light source for diffused light and the light source for directional light, is provided, and the illumination control section carries out a switch operation for switching over lighting of each light source, and an adjustment operation for changing illumination intensity of each light source.

5. (Amended) The illumination apparatus as set forth in any one of claims 2 through 4, characterized in that said reflection plate is a side end face of an inner surface of the case which provides accommodation for said light source and said diffusion plate.

6. (Amended) The illumination apparatus as set forth in claim 5, characterized that at least a side end face of said case inner surface is of a white color or a metal color.

7. (Amended) A recognition apparatus characterized by being equipped with the illumination apparatus which was described in any one of claims 2 through 6, an image pickup camera which picks up an image of the object to be detected, which was illuminated by the illumination apparatus, and a control section which caries out recognition processing of the object to be detected, by use of the image which was picked up.

8. (Amended) A component mounting apparatus which has an absorption nozzle, with which a transfer head, which moves on the upper side of a substrate, was equipped, absorbed and held a component, and transfers said transfer head to mount the component on the substrate at a predetermined position,

characterized in that a recognition apparatus which is disposed on said transfer head and detects a mark for alignment which was disposed on said substrate and corrects a mounting position of said component depending on a detection position of the mark for alignment is the recognition apparatus which is described in claim 6.

9. (Amended) A component mounting apparatus which has an absorption nozzle, with which a transfer head, which moves on the upper side of a substrate, was equipped, absorbed and held a component, and transfers said transfer head to mount the component on the substrate at a predetermined position,

characterized in that a recognition apparatus which is disposed on the lower side of said transfer head and recognizes a component which was absorbed and held by said absorption nozzle is the recognition apparatus which is described in claim 6.